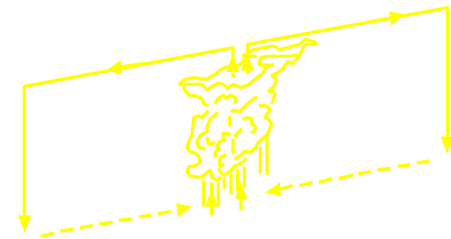

Accelerator Mass Spectrometry: A Powerful Tool for Environmental & Biological Sciences

John P. Knezovich

Center for Accelerator Mass Spectrometry (CAMS)

Lawrence Livermore National Laboratory

Understanding the past, exploring the future



What is Accelerator Mass Spectrometry?

- n* A highly sensitive and precise technique for measuring isotope ratios**
 - Separates and counts atoms instead of measuring radioactive decay
 - Unmatched sensitivity
 - n* Can quantify attomoles of atoms (i.e., 10^{-18} M)
 - n* Small sample size (<1mg)
 - Rapid analysis time (~mins.)
- n* Isotopes can be used as chronometers and tracers**
 - Applications are only limited by the ingenuity of the researcher

CAMS Facts

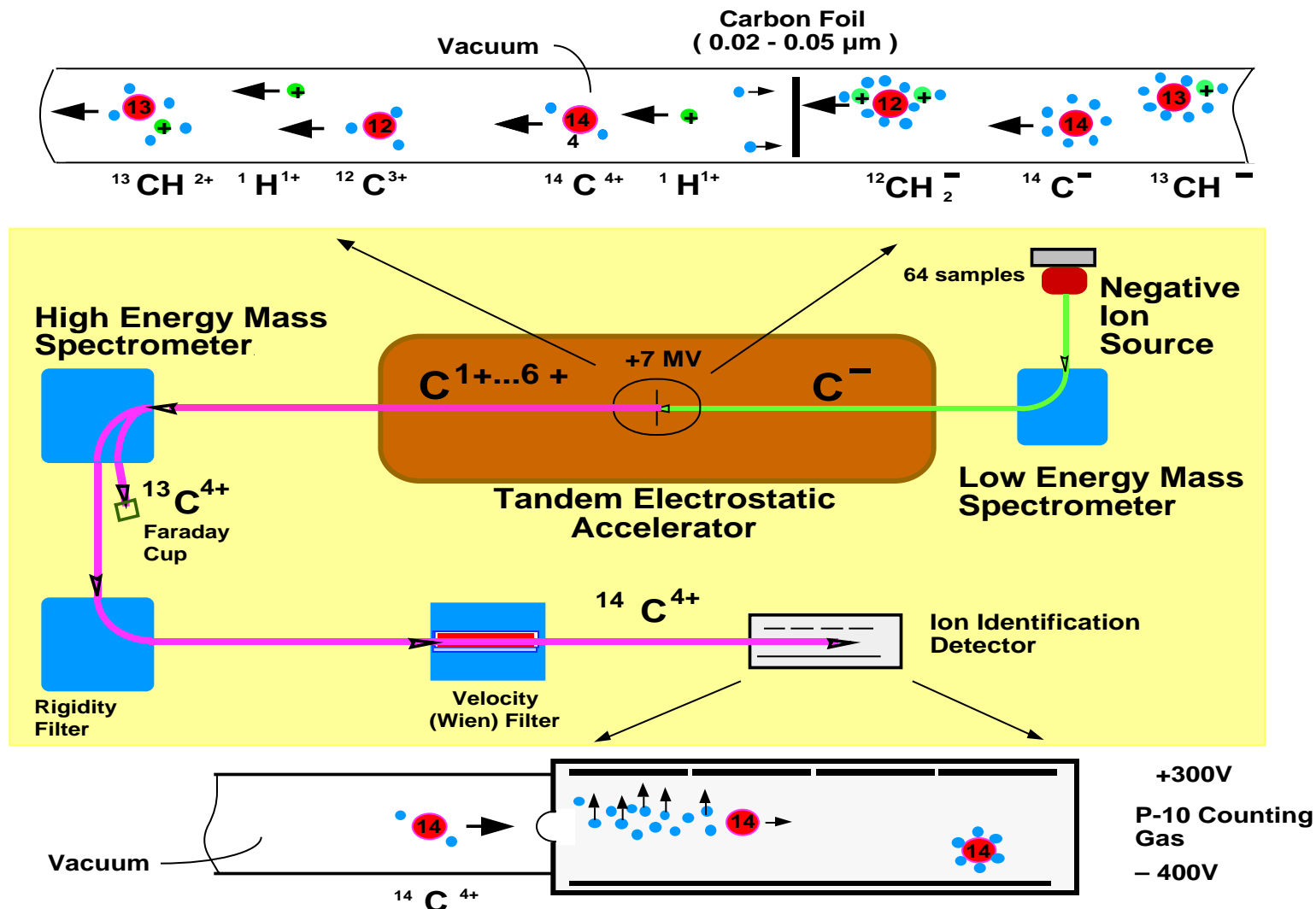
***n* Most versatile and productive AMS facility in the world**

- Routine measurement of ^3H , ^{10}Be , ^{14}C , ^{26}Al , ^{36}Cl , ^{41}Ca , ^{63}Ni , ^{99}Tc , ^{129}I , ^{239}Pu
- ~20,000 analyses performed per year

***n* Contribute to national needs in carbon sequestration, climate change, geo- and bio-sciences**

- Recently named a National Center for biomedical applications

Isotopes are accelerated and separated based on their mass

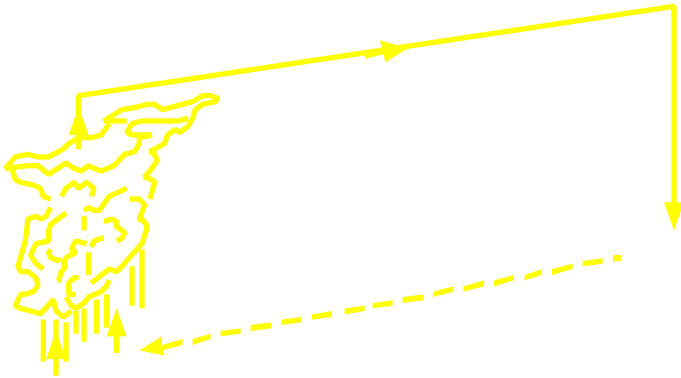


CAMS 10-MV AMS System

Bomb Radiocarbon as a Tracer of Global Environmental Processes

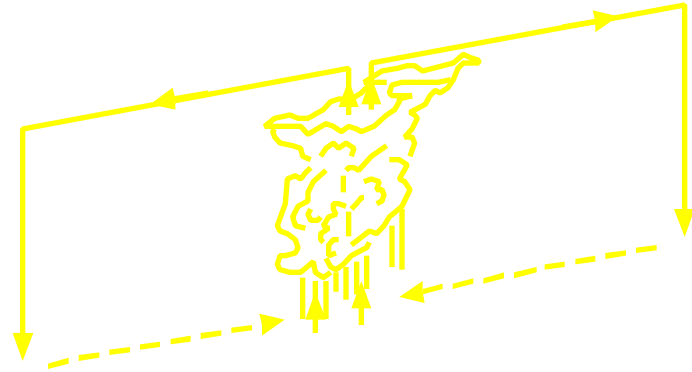
El Niño - Can we measure its frequency?

NORMAL



**STRONG TRADE WINDS
EAST-WEST THERMOCLINE GRADIENT
UPWELLING IN EASTERN EQ. PACIFIC**

El Niño



**WEAK OR REVERSED TRADE WINDS
REVERSED THERMOCLINE GRADIENT
LITTLE OR NO UPWELLING IN EAST**

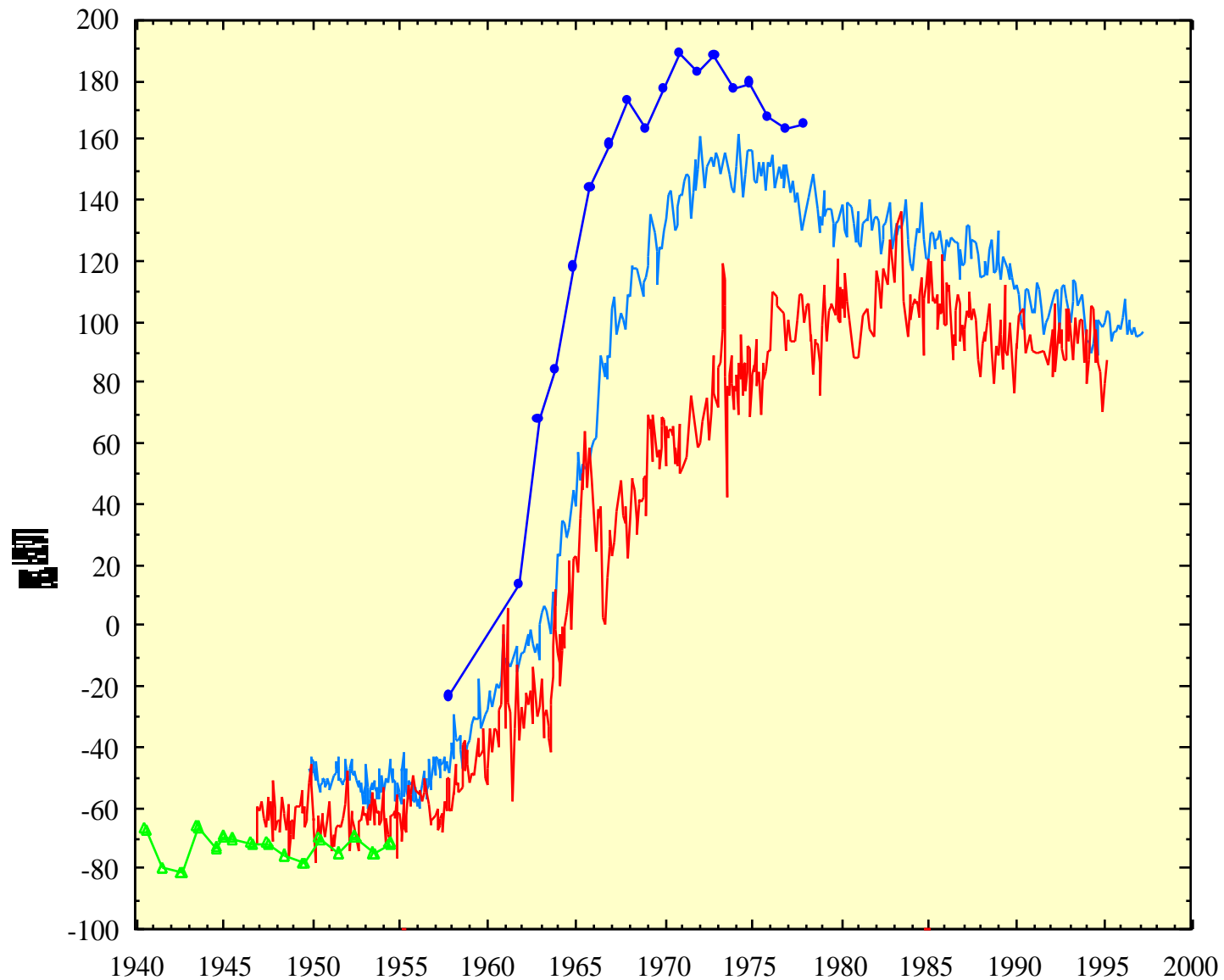
Corals as monitors of oceanic processes

Radiocarbon (^{14}C) is a conservative water tracer, and is not influenced by biology

Coral skeletal ^{14}C = water ^{14}C

Therefore, corals should be able to tell us how rapidly CO_2 is absorbed by the ocean and to what extent the ocean mixes

High-Resolution Coral ^{14}C Tracks Ocean Circulation & Climate



We are at the forefront of a revolution

- n* “Physics Loses Limelight to Biology” *U.S. News & World Report*, March 29 (1999)**
- n* “U.S. Universities are now promoting collaborations between physics and biology” *Nature* 397:3 (1999)**
- n* Biosciences now account for >43% of federal funding for basic research (up from ~30% in 1970)**
 - An aging population coupled with increased needs for health care are fueling this trend**

Pressing questions

***n* Toxicology, Pharmacology, Nutrition**

➤ Are data obtained from high-dose experiments relevant?

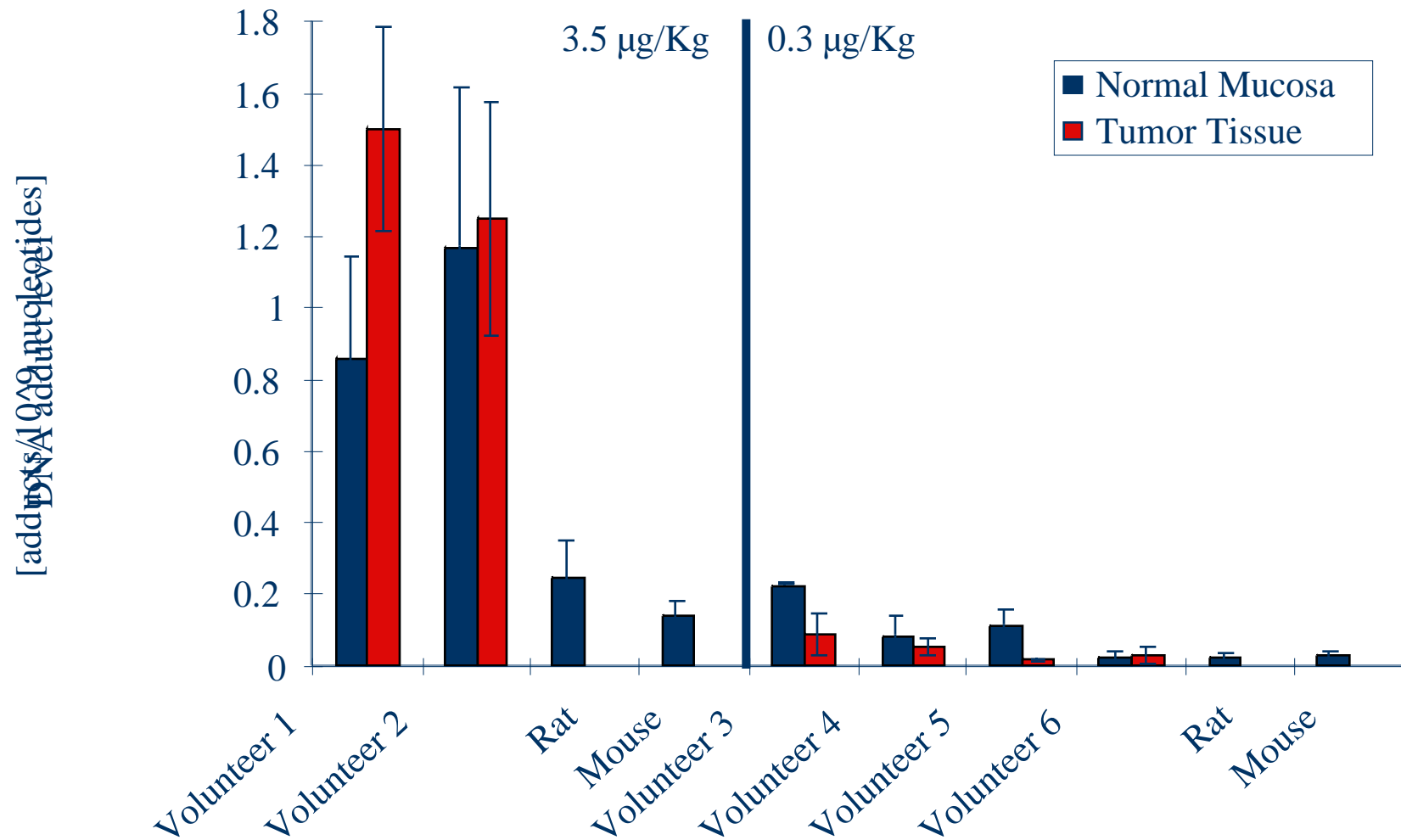
***n* Is it possible to determine the impact of low, environmentally-relevant exposures?**

➤ Are animal models valid?

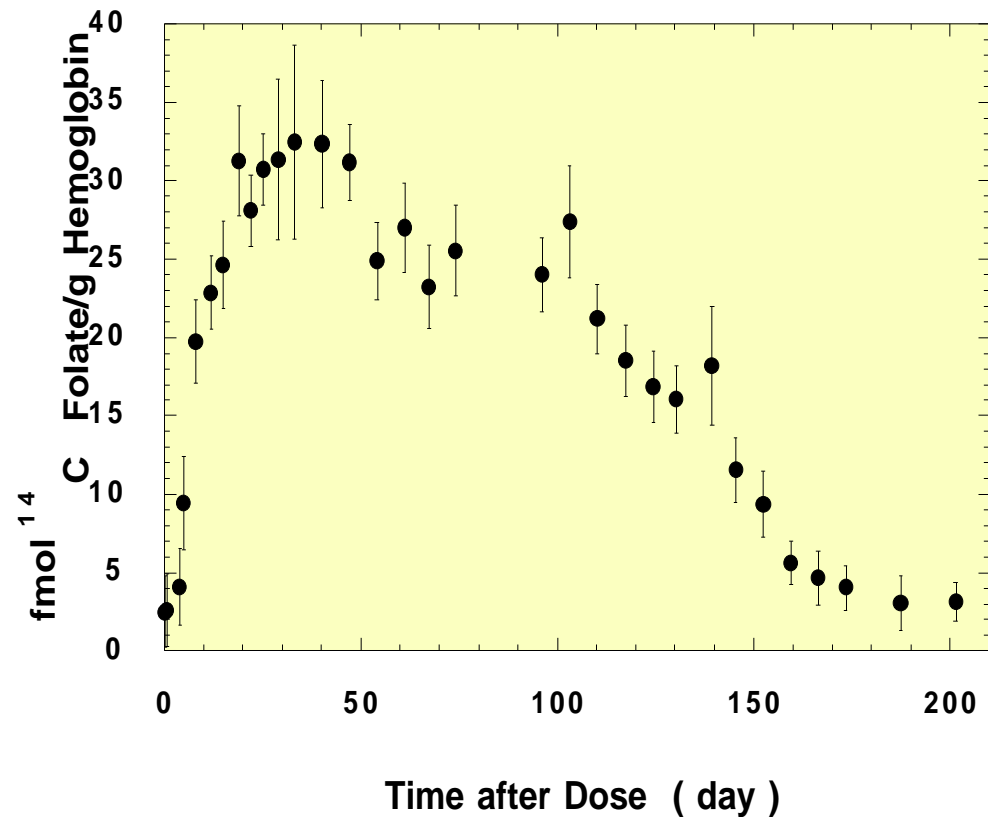
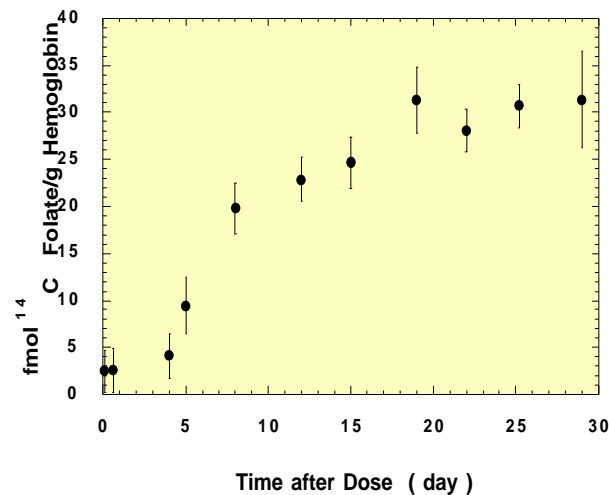
***n* Are studies with human subjects feasible?**

***n* AMS provides the sensitivity and precision needed to address these questions**

The amount of a mutagen formed in grilled food was used to determine its potential risk to humans



A single dose of folate was traced for 200 days



Folate incorporation begins at day 5 and serves as an index of blood cell life time

Where do we go from here?

- n AMS has the sensitivity and precision to address a multitude of environmental and biomedical questions**
- n Merging the fields of physics, chemistry and biology (as well as others) will continue to create new insights and opportunities**
- n Newer, smaller spectrometers will proliferate over the next ten years**

CAMS Spectrometers

Radiocarbon Dates for Teachers!

Free!!!

From the Center for Accelerator Mass Spectrometry

Lawrence Livermore National Laboratory

PROPOSAL DEADLINE November 1, 2000

(Samples should be between 350 and 50,000 years old)